The Dulmison BFD is available in a variety of colors and different sizes to accommodate wires ranging from 0.175 to 1.212 inches (Figure 4-9).

The BFD has been effective when tested on transmission overhead static wires in Europe, where typical spacing ranges from 16 to 33 feet. In North America, the BFD also has shown to be effective in reducing waterfowl collisions with overhead static wires (Crowder 2000). The BFD is believed to be effective because its profile increases line visibility. As with "active devices" such as the Flapper, these more "passive" devices have not been tested on communication tower guy wires; however, it is assumed that they would increase the profile and, therefore, the visibility of the guy wires during daytime conditions.

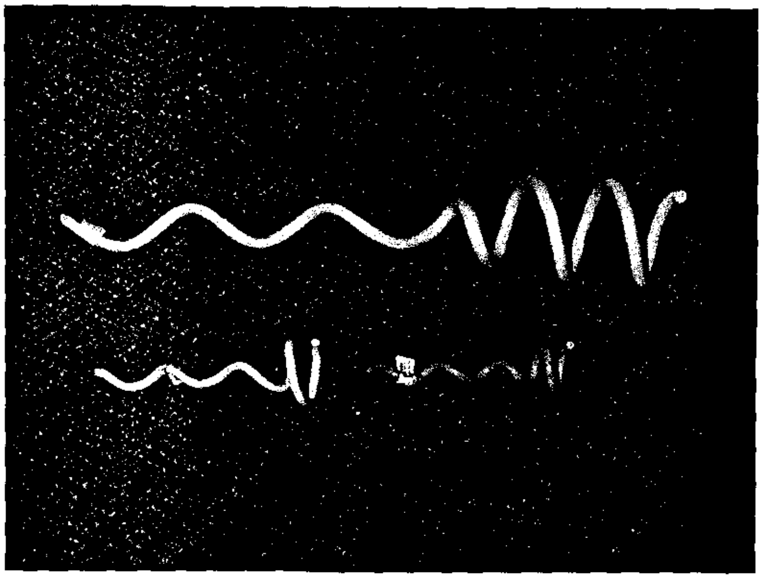

Figure 4-9 Bird Flight Diverters for Small and Larger Wires

Regarding long-term use, BFD colors may fade after long periods of exposure but should not become brittle or lose their elastic properties. ESKOM has used the Preformed Line Products, BFD in South Africa for years with no reports of mechanical failure (van Rooyen 2000) although some red PVC devices have faded.

4.2.1.4 Swan Flight Diverter

The Swan Flight Diverter (SFD) is similar to the BFD but includes four 7-inch spirals (Figure 4-10). The SFD also is made from a high-impact, standard gray PVC and is UV stabilized. The Dulmison SFD is available in a variety of colors and sizes to accommodate wires ranging from 0.175 to 1.212 inches.

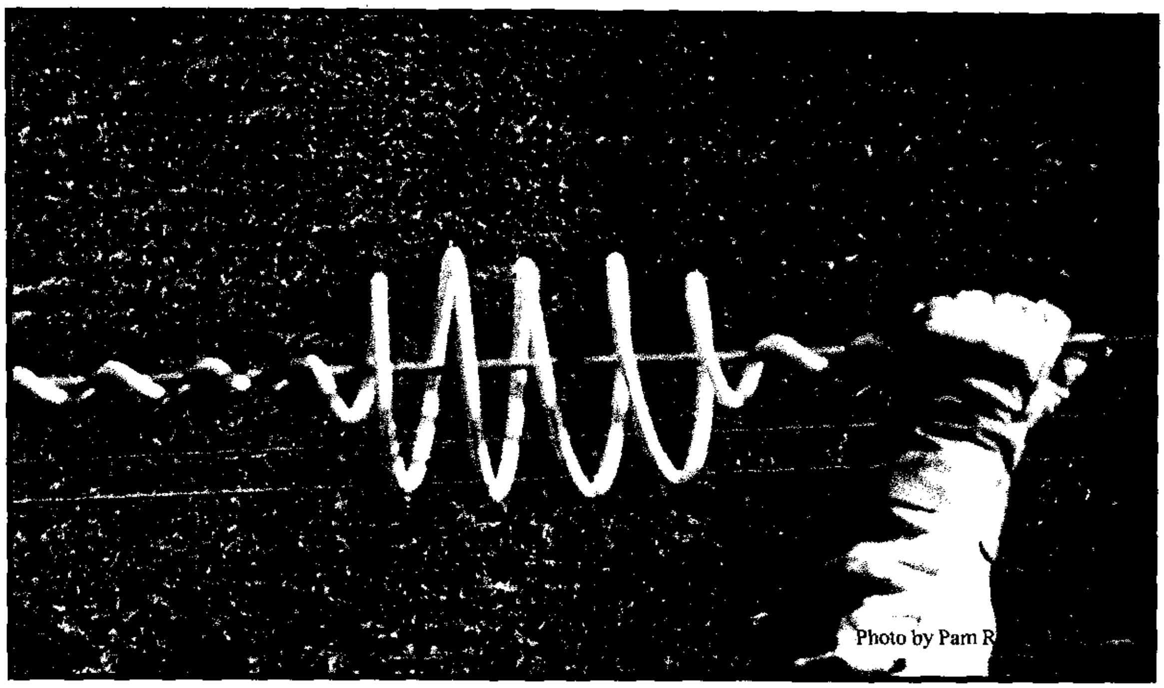

Figure 4-10 Swan Flight Diverters Being Placed on a Static Wire

As with the BFD, the SFD has been shown to be effective when installed on transmission overhead static wires in North America, but has not been tested on tower guy wires. In the early 1990's Northern States Power Company addressed a problem where endangered trumpeter swans were colliding with a power line during the winter months in a small bay on the St. Croix River in Hudson, Wisconsin. Yellow SFDs were installed to increase the smaller-diameter shield wires' visibility in low light conditions. The SFDs were installed May of 1996, using a 50-foot spacing staggered on each parallel shield wire, resulting in an appearance of a 25-foot spacing. To date no additional collisions or deaths have been documented (Rasmussen 2001).

In Indiana, the SFD also has recently shown to be effective in reducing waterfowl collisions with static wires on overhead transmission lines (Crowder 2000). The spacing of the SFDs in Crowder's 1998-2000 study was 20 feet apart. Figure 4-11 provides a representative view of SFD spacing on transmission line static wires. Whether this type of spacing would aid in increasing communication guy wire visibility remains to be tested.

As discussed for BFDs, the SFD colors may fade after long periods of UV exposure but should not become brittle or lose their elastic properties.

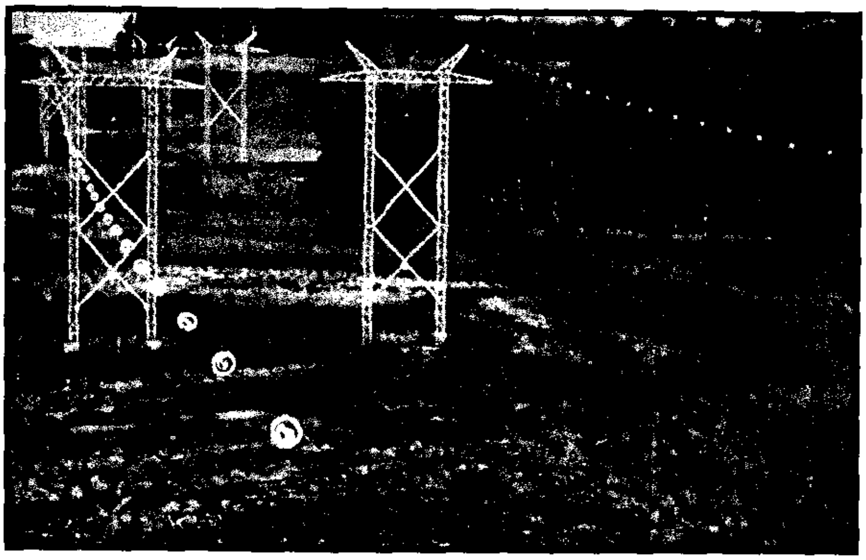

Figure 4-11 Swan Flight Diverters Installed at a 20-foot Interval in Indiana

4.2.1.5 Spiral Vibration Damper

Spiral Vibration Dampers (SVDs) are manufactured from solid PVC into a helix (Figure 4-12). The original purpose of the damper was to reduce high-frequency aeolian vibration on power lines. The SVD is designed to provide the action/reaction motion to oppose the natural vibration of cable by gripping a line tight at one end; loosely on the opposite end. The vibration is often inducted by low velocity winds of 3 to 8 mph.

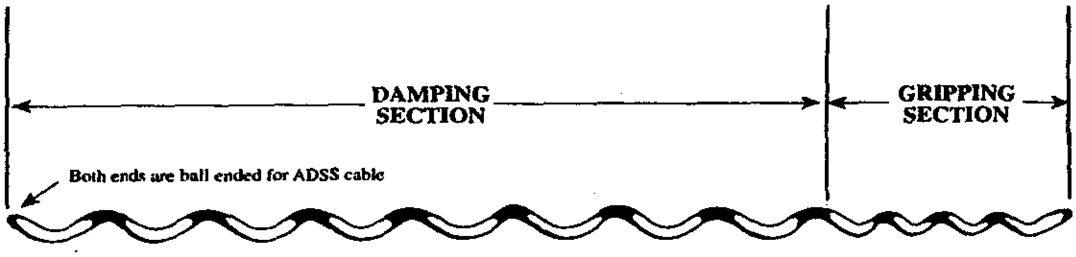

Figure 4-12 Spiral Vibration Damper

The Dulmison SVD is made from a high-impact, standard UV-stabilized PVC. The SVD also is available in a variety of colors, and there are different sizes available to accommodate a wire ranging from 0.175 to .76 inch.

SVDs have been used in the San Luis Valley in Colorado to mitigate crane collisions on overhead power lines. As an example, coverage of the overhead wires was 27.5 percent per span, reducing collisions by 61 percent. As discussed for BFDs and SFDs, the SVD has not been tested on guy wires, and the SVD colors also may fade after long periods of UV exposure but should not become brittle or lose their elastic properties. Tri-State Generation and Transmission Association has used the Dulmison and Preformed spiral vibration dampers since 1985 without any failures (Dille 2001). The dampers are easy to install; however, after several years they do become brittle and will break if they need to be removed.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The siting and construction of communication towers is becoming an increasingly important issue in North America. It is difficult to predict with any significant level of certainty, the relative incidence of bird collisions anticipated for a proposed communication tower site without pre-construction site analyses and pre- and post-construction monitoring programs. With increased public and agency awareness and scrutiny of this growing problem, a better established and more rigorous review process may be developed in the future. This process would incorporate a greater degree of site-specific analyses, short- or long-term field studies, increased regulatory review, and additional public participation in the permitting process.

Although most of the causes and possible solutions for increased avian mortalities associated with communication structures remain speculative, a few conclusions have been advanced with some degree of confidence within the scientific community studying this problem. Among them include:

- The largest bird kills tend to occur on nights with low visibility conditions, especially fog, low cloud ceiling, or other overcast conditions.
- All other things being equal, taller towers with lights tend to represent more of a hazard to birds than shorter, unlit towers.
- Towers with guy wires are at higher risk than self-supporting towers.
- Two collision mechanisms appear to be a factor in bird collision: 1) blind collision and 2) illuminated sphere of influence.
- Certain avian families or species tend to be more affected than others, among them vireos, warblers, and thrushes.
- The seasonal pattern exhibits a pronounced collision spike during fall migration and another smaller spike during spring migration. However, bird collisions with towers can occur any time of the year under any weather condition.

- There are no studies to date that demonstrate an unambiguous relationship between avian collisions with communication towers and population decline of migratory bird species.

- Although biologically significant tower kills have not been demonstrated in the literature, the potential does exist, especially for threatened and endangered species.

- More research is warranted in order to identify specific causes and possible solutions to this problem.

5.2 RECOMMENDATIONS

It is clear that birds collide with communication towers. However, to understand why those collisions occur, additional research is needed. This subsection proposes further actions necessary to reduce the substantial uncertainty associated with the magnitude of bird collisions and causative factors, and provides direction for future studies.

The communication industry is not unique in addressing avian issues. Avian interactions occur with a variety of man-made infrastructure. These interactions include electric distribution power line electrocutions, transmission power line bird collisions, and wind turbine bird and bat collisions. These industries and associated interest groups have responded by developing guidance documents to aid in understanding the problem and providing standardized approaches to studying the problem. These documents also provide state-of-the-art knowledge on how to better define and mitigate problems. Examples of existing guidelines include the following:

- *Studying Wind Energy/Bird Interactions - A Guidance Document (NWCC 1999)*

- *Mitigating Bird Collisions With Power Lines: The State of the Art in 1994 (APLIC 1994)*

- *Suggested Practices for Raptor Protection on Power Lines: the Stare of the Art in 1996 (APLIC 1996)*

Much of the information contained in these documents would be directly applicable to the telecommunication industry with applicable, representative changes.

It would be to the FCC's advantage to develop a parallel guidance document for the telecommunication industry.

The following short- and long-term recommendations shown in Table 5-1 provide a basis for developing this type of guidance document. Many of these recommendations are inter-related and inter-dependent and reflect concerns and questions identified from the NOI responses, industry input, and ongoing dialog with the Communication Tower Working Group. Because many of these suggested recommendations also are complex and potentially controversial, the applicable approaches would need to be delineated in detail, in accordance with regulatory requirements and methods that are scientifically valid. Development of this type of document also would show a proactive stance by the FCC and initiate valuable working relationships integral to answering some of these outstanding questions and identifying future actions. In addition, the short-term recommendations are listed according to suggested priorities in Table 5-2.

TABLE 5-1

RECOMMENDATION MATRIX BY TOPIC

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	**Long Term (1 to 3 years)**
Research Oversight			
1. There is great value in structuring an oversight research organization for the communication tower industry. Examples of parallel national organizations for other industries include the: Electric Power Research Institute (EPRI), Avian Power Line Interaction Committee (APLIC), and National Wind Coordinating Committee's (NWCC) Avian Subcommittee. The intent would be to establish an organization that could tier off of the efforts and communications to date (e.g., Communication Tower Working Group, RESOLVE) to direct research design, investigate funding options, manage information distribution, encourage communications, and aid in problem and dispute resolution. This organization also could provide a clearinghouse for data review. A critical component of this would be to create a way to assist with funding of needed science. This could be accomplished by partnering with other groups already	1. Continue participation in the Communication Tower Working Group and monitor and provide comments, where appropriate, on proposed research projects. Specifically, support the existing Research Subcommittee of the Communication Tower Working Group that would focus on developing mitigation measures and other information important in understanding the factors contributing to bird collisions.	X	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority Short Term (6 to 12 months)	Long Term (1 to 3 years)
funding communication tower research, such as EPRI.			
2. There are a number of ongoing studies including: o Michigan State Police Tower Study o Clear Channel of Northern Colorado Tower Study o Coconino and Prescott National Forest Tower Study o Philadelphia Tower Study o Mobile Lighting Study o U.S. Coast Guard "Rescue 21" Study The results should become available over the next 12 to 36 months.	2. Review the results of these studies as they become available and incorporate relevant results and conclusions into their review of FCC tower applications and, where appropriate, provide comments on these applications.		X
Standardized Methods and Metrics			
1. When examining the studies and incidental reporting of bird mortalities within the last 50 years, it is apparent that few data have been collected with a standard or systematic way that allows for comparison with other studies or to be able to draw conclusions. One of the more important aspects for planning future	1. Initiate dialog with applicable research entities and telecommunication industry to identify the most appropriate approach and mechanism to develop standardized methods and metrics for data collection and monitoring. These standardized approaches could tier from existing	X	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
studies on bird interactions with communication towers is to develop a system of standardized methods and metrics for finding and reporting bird mortalities. Kerlinger (2000b) outlines some of the necessary components of developing standard methods and metrics including developing a metric such as the number of birds killed per tower per unit of time and species-specific fatality rates. In addition identify independent variables that are standardized such as the lighting, the guy wires, tower height, location (*e.g.*, geography and topography). In addition, the Communication Tower Working Group's Research Subcommittee's Integrated Nationwide Research Proposal - "Causes and Solutions to Bird Strikes at Communication Towers," may provide information and a basis for standardizing applicable study methods.	references for avian collision studies and would closely inter-relate with other short- and long-term recommendations. 2. From these communication and coordination efforts, produce a comprehensive guidance document with input from applicable research entities and telecommunication industry. Producing this type of guidance and direction for both the telecommunication industry and associated research groups would be critical to standardizing the research approaches and facilitating problem resolution relative to avian collisions at tower sites.		X
Study Biases			

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
1. Estimating dead and injured birds can result in an underestimation of mortality if biases are not taken into account. Studies should incorporate the following four main biases: • Scavenger/Predator Removal Bias • Crippling Bias • Searcher Efficiency Bias • Habitat Bias	1. In developing a guidance on standard methods (See Standardized Methods and Metrics Recommendation), provide recommendations accounting for the four study biases or develop a statement for the need of standardizing monitoring methods to account for these biases	X	
Tower Lighting			

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
1. Nocturnal migrating birds are thought to be attracted to artificial light sources on communication towers. The mechanisms for this attraction are not well understood. In addition, no firm conclusions can be drawn, based on the existing literature, regarding the importance of different lighting colors, durations, intensities, and types (e.g., incandescent, strobe, neon, or laser) on bird attraction in conjunction with other factors (e.g., certain weather conditions that increase or decrease the risk of bird collisions with lighted communication towers). A number of research investigations on lighting and communication towers are in progress.	1. Continued research in these areas should be supported or encouraged (See Avian Vision Recommendation). The results of these and other investigations need to be evaluated to better define the relationship of lighting and communication towers and incorporated into any recommendations for tower lighting.	X	
Data Gaps and Research Needs			

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority Short Term (6 to 12 months)	 Long Term (1 to 3 years)
1. Present studies do not establish the degree of impact that mortality at towers is having on migratory and resident bird populations. It is documented that avian mortality does occur at communication towers; however, the extent this mortality is having on bird populations is unknown. Although there have been numerous studies on tower collisions, very few comparative studies have been completed.	1. Provide guidance on the need for both comparative studies and studies investigating the factors contributing to mortality (See Standardized Methods and Metrics Recommendation below).	X	
Species Differences and Susceptibility to Tower Collisions.			
1. Nocturnal migrants, such as warblers, vireos, thrushes, and sparrows appear to be more susceptible to tower collisions than other species. Diurnal species most affected appear to be fast-flying species, such as waterfowl and other waterbirds. Differences among various taxa of nocturnal migrants in response to tall, lighted structures warrant further research.	1. Provide guidance on compiling data as part of the standard methods to provide insight into family or bird group behavior differences that may identify why some species are more susceptible to collisions and how losses of certain species could be reduced. This can only occur after additional research is conducted in this area.	X	
Monitoring Migration Patterns			
1. In an effort to standardize future study	1. Encourage the development of this	X	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority: Short Term (6 to 12 months)	Priority: Long Term (1 to 3 years)
methodologies to monitor bird interactions with communication towers, it would be advantageous to establish baseline information on bird densities, movements, altitudes, and behaviors during migration in proximity to tower sites. If bird mortality corrected for study biases is monitored at a site at the same time as bird abundance is monitored then the relationship between mortality and abundance can be established and risk factors can be developed.	information as a part of the standardization of methods (See Standards and Metrics Recommendation).		
Avian Vision and Avoidance Behavior.			
1. Knowledge about avian vision is lacking, particularly as it pertains to nocturnal neotropical migrants. To what degree do night flying migrants avoid tower and guyed wires? What is the avoidance behavior of diurnal species? What conditions enhance or diminish a bird's ability to avoid collisions? Future application of such research to try to answer some of these questions involving bird vision and behavior would greatly enhance the knowledge to develop mitigation measures. A high research priority is to	1. Since FAA is the lead agency in lighting issues, FCC should encourage research on avian vision.	X	
	2. Avian vision research should initially be laboratory-controlled studies and then field applications, tiering off of the work completed to date by Beason (2000). These would be long-term studies first using representative model species		X

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
determine why birds appear to be attracted to certain lighting regimes.	followed by confirmatory field studies. Some limited research on avian vision has been conducted regarding bird collisions with wind turbines but research is not applicable to lighting.		
	3. Recommend that during tower monitoring studies information be collected not only on mortality but also abundance and any behavioral avoidance exhibited by birds attempting to avoid collisions.	X	
Mitigation Measures			
1. No products have been tested specifically on communication tower guy wires to mitigate bird collisions. Although several products are available to mark overhead power lines, there have been very few rigorous experimental designs to test their effectiveness on electric lines and no studies have been	1. Encourage research on potential measures that mitigate avian mortality at communication towers, especially mass mortality events.	X	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
completed to date on communication tower guy wire. Also, very few studies comparing products have been completed. Although no marking devices has been tested on communication towers and their associated guy wires, they have had varying levels of effect on power lines. It is likely that different devices may work for certain areas under certain conditions, but applications need to be tested, accordingly.	2. Conduct a review of the applicability of mitigation measures proposed for transmission lines and wind turbines as they may pertain to the telecommunication towers.	X	
Biological Scoping.			
1. Pre-permitting review and compliance under NEPA has been a controversial topic in the past by opponents of communication tower siting. Compliance with the Migratory Bird Treaty Act, the Endangered Species Act, and the Bald and Golden Eagle Protection Act are part of the NEPA review. Establishing applicable biological scoping issues for avian collisions with telecommunication towers would be in compliance	1. Develop a more specific set of FCC National Environmental Policy Act (NEPA) biological scoping issues for the Environmental Checklist Assessment. These scoping issues should reflect the factors that are known to be associated with avian mortality (See Chapter 3) to the extent that information is known at	X	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	**Long Term (1 to 3 years)**
with these bird protection Acts and simultaneously narrow the issues to focus of environmental assessment aiding the FCC in making applicable NEPA decisions.	this time. The checklist should be expanded to reflect these issues. If an environmental assessment is warranted based on the checklist guidance for the applicant in standard methods (See Standard Methods and Metrics Recommendation), it should be referenced.		
U.S. Fish and Wildlife Service Interim Guidelines for Recommendations on Tower Siting, Construction, Operation, and Decommissioning.			
1. Some of the NOI responses indicated that some of the specific guideline recommendations might be in conflict with each other. For example they cite, limiting tower height <200 feet may be unattainable in certain areas. They state difficulty of collocating multiple carriers while minimizing tower height. They also state that keeping towers <200 feet will likely require a greater number of towers, which is in opposition to the USFWS guideline recommending minimizing the number of towers.	1. Provide a vital role in readdressing the voluntary guidelines to eliminate some of the confusion regarding their voluntary implementation by providing comment on those components where more research is needed before definitive recommendations are proposed.	**X**	

TABLE 5-1

RECOMMENDATION MATRIX, CONTINUED

Recommendation Topic and Discussion	Recommendation	Priority	
		Short Term (6 to 12 months)	Long Term (1 to 3 years)
Tower Siting			
1. The siting and construction of communication towers is becoming a more prominent issue in North America. It is difficult to predict with a high level of certainty the relative incidence of bird collisions anticipated for a proposed communication tower site without pre-construction site analyses and pre- and post-construction monitoring. With increased public and agency awareness and scrutiny of this growing problem, a more established review process may be needed in the future. The USFWS has developed a Potential Impact Index (PII) as a tool to evaluate the ecological value of potential wind turbine locations. The PII is a standardized, quantifiable tool using landscape-scale information for wind turbine siting to minimize ecological impacts, including bird and bat collisions. Similar parameters and criteria could be used with some modifications for communication towers and geographical location. Other parallel processes also could be developed depending on their applicability.	1. Develop appropriate criteria or ecological parameters to be used in communication tower siting. Similar approaches to that used for wind turbines should be examined for potential applicability and adaptation for communication tower sites.		X
	2. Modify the PII process or develop a similar process for analyzing project siting for telecommunication towers.		X

Table 5-2

SHORT-TERM RECOMMENDATIONS BY PRIORITY

Priority	Recommendation
1	**Research Oversight** - Continue participation in the Communication Tower Working Group (CTWG) and monitor and provide comments where appropriate on proposed research projects. Specifically FCC should support the existing Research Subcommittee of the CWTG that would focus on developing information important in understanding the factors contributing to bird collisions. This should be done in conjunction with Priority 5.
2	**Standardized Methods and Metrics** - Initiate dialog to identify the most appropriate approach and mechanism to develop standardized methods and metrics for data collection and monitoring. Produce a comprehensive guidance document with input from applicable research entities and telecommunication industry.
3	**Study Biases** – Develop a statement for the need of standardizing monitoring methods to account for the four primary study biases.
4	**Tower Lighting** - Support and encourage continued research on tower lighting and how it relates to avian vision.
5	**Data Gaps and Research Needs** - Provide guidance on the need for both comparative studies and studies investigating the factors contributing to mortality. This guidance should be based on information developed in Priority Recommendations 2 and 3 and also reflect Priority 4.
6	**Species Differences and Susceptibility to Tower Collisions** - Provide guidance on compiling data as part of the standard methods to provide insight into family or bird group behavior differences that may identify why some species are more susceptible to collisions and how losses of certain species could be reduced.
7	**Monitoring Migration Patterns** – Support the development of standardized methods to monitor migration patterns pertaining to birds at greatest risk of tower collision.
8	**Avian Vision** - Compile existing information on avian vision and encourage additional research.
9	**Avoidance Behavior** - Recommend that during tower monitoring studies information be collected not only on mortality but also abundance and any behavioral avoidance exhibited by birds attempting to avoid collisions.
10	**Mitigation Measures** - Research measures to mitigate mass mortality events.
11	**Biological Scoping** – Develop a specific set of FCC National Environmental Policy Act (NEPA) biological scoping issues and revise the environmental assessment checklist.
12	**U.S. Fish and Wildlife Service Interim Guidelines** - Readdress the voluntary guidelines to eliminate confusion regarding some of the specific recommendations based on this technical review.

SECTION 6
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